REMARKS/ARGUMENTS

In the Office Action, claims 13-16 and 18-30 were rejected. After consideration of the Office Action, claim 13 has been amended. Claims 13-16 and 18-30 are under consideration in the present application. Applicant respectfully requests reconsideration of the application by the Examiner in light of the above amendments and the following remarks.

102(e) rejection of claim 13 on Hwang US20040161575 as evidenced by Arnone WO-00-75641 (with US6828558 as translation)

Applicant notes the Office action response to Applicant's earlier arguments:

> 12. The applicant's main argument is that the materials used in the masking layer are not nonlinear materials, and that the addition of nanoparticles to the material is what causes the material to exhibit non-linear properties. The teachings of Arnone et al. and Yamamoto et al. are used to show that at least $Si0_2$ and ZnS exhibit non-linear optical properties. Applicant has the burden of distinguishing their invention from the prior art.
>
> The applicant broadly recites the use of organic materials as the non-linear optical material of the masking layer. Applicant has the burden, if in disagreement, to show that the organic resins recited by Iida do not exhibit non-linear optical properties. The applicant's disclosure regarding acceptable materials for use as the non-linear optical material of the masking layer is extremely vague. Disclosure of specific materials or addition of inventive examples would help to make the specification clearer and would have helped in the examination of this application. However, addition of such specific materials would be considered new matter.

Applicant respectfully disagree with the characterization of the first sentence in the first paragraph and state that it is not the nanoparticles that cause the non-linearity in Applicant's invention that is recited in claim 13.

In the present amendment, Claim 13 has been amended to further clarify the definition of "nonlinear" and recites:

> 13. An optical disk comprising:
> a data layer;
> a mask layer overlying the data layer and comprising a nonlinear optical material and nanoparticles embedded in the nonlinear optical material, wherein the nonlinear optical material is configured for providing an effective aperture within the mask layer upon a gate beam having a power ranging up to about 10 milliwatts being directed at the optical disk, and wherein the nanoparticles are configured for increasing a local field intensity; and
> a substrate situated on at least one outer surface of the optical disk.

Support for this amendment may be found in paragraphs 26 and 33, for example.

Applicant respectfully submits that Hwang as evidenced by Arnone does not teach or disclose these claim 13 recitations. As stated in the prior amendment, Hwang does not describe the dielectric materials in the mask layer as comprising a non-linear optical material. Applicant notes that the present Office action asserts that Hwang mentions ZnS and that Arnone mentions that ZnS has non-linear properties.

To excite the nonlinear properties of ZnS, however, higher laser intensity is needed than as envisioned in Applicant's optical disk invention. In Arnone's patent, ZnS functions as an emitter crystal to generate THz pulse when it is excited by a visible laser pulse. In this type of situation, it is common practice that femto-second (fs) or pico-second(ps) laser pulses are necessary in order to excite the nonlinearity of the emitter material. These pulses have intensity on the order of GW/cm^2. In a reference which Applicant is attaching herewith, Krauss et al.,

Femtosecond measurement of nonlinear absorption and refraction in CdS, ZnSe, and Zns," Applied Physics Letters, 65 (14), 3 October 2004, the nonlinearity of ZnS was measured and shown that about 1GW/cm^2 intensity is needed to excite the nonlinearity of the ZnS at 610nm and about 50GW/cm^2 intensity is needed at 780nm. In Hwang's case, as reported in paragraph [0040], Experiment example 1, increased C/N was achieved when using only 4mW laser power (P) at wavelength (lambda) 635nm with numerical aperture (NA) 0.6. This corresponds to a laser intensity of about 0.36MW/cm^2 (calculated using P/(lambda/NA)^2). This laser intensity is at least 3 orders of magnitude smaller than the laser intensity needed to excite the nonlinearity of ZnS.

In claim 13 as recited by Applicant, the nonlinear property of the matrix material in the mask layer has active functionality, as described in Applicant's paragraphs [0011] and [0025]-[0028]. The resonance of the nano-particles is enabled by changing the refractive index of the matrix material due to its nonlinear response to a laser beam. Due to the nonlinear response, the effective beam size is reduced to gain an "aperture-like" benefit to achieve higher resolution; and the nano-particles additionally enable a local field enhancement (which improves the signal level).

Accordingly, Applicant respectfully the withdrawal of the 102(e) rejection of claim 13 on Hwang as evidenced by Arnone.

102(b) Rejection of claim 13 on Nomura, Japanese Journal of Applied Physics (Nomura 1) as evidenced by Yamamoto US2003-0152739

Applicant respectfully submits that Nomura 1 as evidenced by Yamamoto does not teach or disclose the above claim 13 recitations.

As stated in the prior amendment, Nomura 1 does not describe the dielectric materials in the mask layer as comprising a non-linear optical material. Applicant notes that the present Office action asserts that Nomura mentions SiO_2 and that Yamamoto mentions that SiO_2 has non-linear properties.

More specifically, the Office action statues:

> Claim 5 of Yamamoto et al. teaches a non-linear optical film containing SiO2. The teachings of this reference are used solely to establish that SiO2 recited by Nomura et al. inherently exhibits non-linear optical properties.

Applicant submits that the material is non-linear doesn't mean that it is the SiO_2 in the material that causes it to be so. In fact, in Claim 1, from which claim 5 of Yamamoto depends, recites "a nonlinear optical thin film comprising an amorphous alloy or a mixture of said amorphous alloy and an oxide glass component and ..." – thus clearly indicating that the nonlinear functional component in this thin film is the amorphous alloy.

Regardless of Yamamoto's description, whether SiO_2 has nonlinear optical properties under some circumstances is different from whether the nonlinear properties of SiO_2 are utilized and relevant to optical disks or the phenomena reported in Nomura 1. Nomura 1 states that "Signal intensity of very small marks was increased by metal nanoparticles ..." and the discussions on Nomura 1 page 1878 indicate that "the size or density of Ag particles influenced the extent of enhancement". The SiO_2 component is not related to the signal enhancement effect described in Nomura 1. Nonlinear response of SiO_2 has been reported when excited by femto-second (fs) laser pulses. (see Borrelli US6977137, for example). However, it requires laser intensity on the

order of about 0.05-1×10^{15} W/cm^2 to excite the nonlinear response (see aforementioned Borrelli, Example 6) . The experiments described in Nomura 1 used 635nm beam, 0.6NA, 1-4mW power with a light intensity of less than 10^6 W/cm^2. This is 8 orders of magnitude smaller than the intensity needed to excite the nonlinearity of SiO_2. Therefore, the phenomena described in Nomura 1 appears to have nothing to do with nonlinearity of SiO_2 in the dielectric layer.

Accordingly, Applicant respectfully the withdrawal of the 102(b) rejection of claim 13 on Nomura 1 as evidenced by Yamamoto

102(b) Rejection of claims 13-15, 20, 23-24 on Nomura JP2002133720 (Nomura 2) as evidenced by Yamamoto US2003-0152739

With respect to claim 13, the above discussion of non-linear materials and SiO_2 is the same for this rejection. Claims 14-15, 20, and 23-24 depend from claim 13. Accordingly, Applicant respectfully the withdrawal of the 102(b) rejection on Nomura 2 of claim 13 as well as claims 14-15, 20, and 23-24 which depend therefrom.

102(b) Rejection of claims 13, 19-20, and 22 on Iida EP 480346

With respect to claim 13, as stated in Applicant's prior amendment, in Iida, the semiconductor nanoparticles are not embedded into a nonlinear optical material (instead the particles appear to be added to the mask material to create the non-linearity) and are not described relative to increasing local field intensity.

More specifically, in Lida, a shutter layer was designed to tighten an irradiated beam. The shutter layer is formed by dispersing semiconductor fine particles into a matrix of glass or resins. The amount of the semiconductor fine particles is 1–80mol% (3/21-23) with higher amounts resulting in particle condensation and lower amounts providing less shutter effect (3/24-30). The shutter effect in Iida is provided by the semiconductor nano-particles not by the glass or resin matrix. In fact, as stated in column 3, lines 34-35, the matrix is for dispersing the semiconductor fine particles. Iida further states that the nonlinear optical effect is produced by the quantum state ("exciton") of the semiconductor fine particles (column 4, lines 15-26). Therefore, the glass or organic resin options recited by Lida do not provide the nonlinear optical properties and neither of them is intended in Iida's patent to be used as a nonlinear material. It is the additional particles that result in the non-linearity

In Applicant's claim 13, the material itself is a nonlinear optical material and the following recitation is included: "wherein the nonlinear optical material is configured for providing an effective aperture within the mask layer upon a gate beam having a power ranging up to about 10 milliwatts being directed at the optical disk, and wherein the nanoparticles are configured for increasing a local field intensity."

These amended claim 13 recitations do not appear to be present in Iida.

Accordingly, Applicant respectfully the withdrawal of the 102(b) rejection of claim 13 (as well as claims 19-20 and 22 which depend therefrom) on Iida.

103(a) Rejections

Claims 13, 16 and 19 were rejected under Hsu US2002154596 in view of Hwang, Nomura 1, or Nomura 2. The Office Action states that Hsu does not teach a mask layer comprising nanoparticles embedded in a non-linear optical material. As discussed above, Applicant also submits that none of Hwang, Nomura 1, or Nomura 2 teach the claim elements relating to the non-linear recitations either. The Office action then states that silver oxide is a non-linear material.

The Office Action more specifically recites:

> Hwang ..., Nomura [2], and Nomura [1] all teach a mask layer containing nanoparticles embedded in a non-linear optical material. Silver oxide is a non-linear optical material.
> It would have been obvious to one of ordinary skill in the art to modify the super-resolution recordable optical disk taught by Hsu et at. by using the mask layers taught by any of Hwang ..., Nomura [1], or Nomura [2], comprising metal nanoparticles embedded in a non-linear optical material with the reasonable expectation of forming an optical recording medium in which the size of the particles in the mask layer can be controlled (Nomura [2] (0005)] and in which capable of high-density recording below the diffraction limit (Nomura [1]) and Hwang ...).

Applicant has amended claim 13 as stated above and submits that Hsu does not teach or suggest the amended recitation with respect to the non-linear material. Therefore, even if the particles of Hwang, Nomura 1, or Nomura 2 were added within the embodiment of Hsu, the elements of Applicant's claim 13 would not be taught or suggested.

Accordingly, Applicant respectfully requests the withdrawal of the 103(a) rejection of claim 13 and claims 16-19 which depend therefrom.

Claim 18 was rejected under 35 USC 103(a) over Hsu in view of any of Hwang, Nomura 1, or Nomura 2 and further in view of Fuji, "A near-field recording and readout technology using a metallic probe in an optical disk," Japanese Journal of Applied Physics Vol. 39 (2000) pp. 980-981; claim 21 was rejected on Iida and Kim WO2004029936; claims 25 and 28-30 were rejected Nomura 2 as evidenced by Yamamoto in view of Perry WO0248432 (US20040079195), and claims 26-27 were rejected on Nomura 2 as evidenced by Yamamoto in view of Sonnichsen, Physical Review Letters. Vol. 88, No. 7, 2002.

These remaining pending claims rejected under 103(a) (claims 18, 21, 25, 22-30) also are each dependent upon claim 13 which Applicant believes to be in condition for allowance for the reasons discussed above. Furthermore, Applicant traverses some of the statements regarding the teachings and *obviousness*.

As one example, with respect to claim 21, as stated above, Iida uses the semiconductor particles to create non-linearity. There does not appear to be any suggestion that such particles would have any purpose or role in a system where a mask material is inherently nonlinear. Thus Applicant traverses the statement on page 10 of the Office Action that it would be obvious to modify the layer of Iida with the non-linear material of Kim. Applicant further requests that, if the Examiner continues to believe such modification to be obvious, the Examiner provide more explicit objective evidence of the obviousness and some indication of a reason why one of ordinary skill in the art would have been prompted to make this combination.

Summary

Applicant respectfully requests that a timely Notice of Allowance be issued in this case. Should the Examiner believe that anything further is needed to place the application in better condition for allowance, the Examiner is requested to contact Applicant's undersigned representative at the telephone number below.

Respectfully submitted,

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Attachments:

Krauss et al., Femtosecond measurement of nonlinear absorption and refraction in CdS, ZnSe, and Zns," Applied Physics Letters, 65 (14), 3 October 2004

Borrelli et al., US 6,977,137, December, 2005